

Appl. No. 10/038,883
Amdmt. Dated February 5, 2007
Reply to Office Action dated November 3, 2006

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REMARKS/ARGUMENTS

Amendments

Claim 1 has been amended to recite that the method is applicable at an OFDM transmitter having at least two transmitting antennas. In addition, the nature of the identical scattered pattern has been clarified. In particular, the scattered patterns are said to be "identical, the scattered pattern of each antenna having offset with respect to the scattered pattern of each other antenna".

See for example Figure 6 where there is a scattered pattern for a first antenna (including symbol 126), a scattered pattern for a second antenna (including symbol 128), and the scattered pattern for the first antenna is offset in time from the scattered pattern for the second antenna, and the scattered patterns are identical.

Claim Objections

Claims 11, 15, 17 and 18 have been amended to replace the expression "adapted to" with "operable to". Note that the steps following this language are not optional.

Claim Rejections 35 U.S.C. 102

Claims 1-4, 6, 21-23, 27-28, 31-32 stand rejected under 35 U.S.C. 102(e) as being anticipated by Li U.S. 6,654,429.

Li discloses a scattered pilot pattern for a single antenna in Figure 4A. However, there is no suggestion of applying such a pattern to an OFDM transmitter having multiple antennas with respective identical patterns being transmitted on each antenna but with an offset as now recited in claim 1.

Claim 3 recites a more precise relationship between the scattered patterns of the antennas. In particular, the subject matter claimed in claim 3 requires the offset between the patterns to be in the time dimension, for example as shown in Figure 5. Figure 5 shows an example where there are two antennas, and there is a regular diagonal-shaped lattice, and each point consists of two pilot symbols on a single sub-carrier for two consecutive OFDM symbols and, where two is

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the number of transmitting antennas, and the two pilot symbols consist of one pilot symbol for each of the antennas.

The portion of Li referred to by the Examiner again only relates to the pattern being transmitted by a single antenna. There is no discussion of multiple antennas or multiple pilot symbols being inserted on N consecutive OFDM symbols, the multiple pilot symbols consisting of one pilot symbol per antenna.

Regarding claim 4, the Examiner refers to Figure 4A. However, Figure 4A does not disclose a diamond-shaped lattice. For diamond-shaped lattice to be created, the pilot in the fourth row of Figure 4A would need to be half way between the pilots in the second row of Figure 4A, and the pilots in the sixth row of Figure 4A would need to be in the same location as the pilots in the second row of Figure 4A, for example.

Regarding claim 6, the portion of Li relied upon by the Examiner is a discussion of a different patent, namely U.S. Patent No. 5,307,376 to Castelain et al. There is a discussion of transmitting pilots with a higher power than remaining symbols in the data stream. However, the remainder of the paragraph makes it clear that this solution is not appropriate for providing channel estimates that are robust to both doppler and delay profiles due to multi-path fading. Furthermore, anticipation rejection requires that all of the claimed elements be recited in a combination that is the same as the manner claimed. It is not appropriate to take a limitation out of the background discussion of another patent and combine that with the remainder of the disclosure.

The Examiner provided no comment on the subject matter of claim 7.

Regarding claim 21 this is a received method and has also been amended to refer to at least two antennas. Furthermore, the claim recites that "for each transmit antenna, receive antenna combination", and where there are at least two transmit antennas and two receive antennas this would be at least four combinations. It is true that Li teaches two receive antennas, but these are simply used as a pair of diversity antennas rather than as receive antennas for the use of MIMO processing of signals transmitted from multiple antennas.

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Claim Rejection 35 U.S.C. 103

All of these claims depend upon one of the above-discussed claims and as such should also be patentable for the reasons presented above.

Claim 7 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Li. To begin, as discussed above, the section of claim 2 referred to by the Examiner is a discussion of another reference, namely U.S. Patent No. 5,307,376. Claim 7 recites not only dynamic adjustment of the power level of the pilot symbols, but a specific manner of doing so, namely as a function of modulation type applied to the sub-carriers carrying data. With all due respect, dynamic power level adjustment should not be equated with simply transmitting pilot symbols with the power level that is higher than the data. There is no dynamic aspect to this type of power level adjustment. Furthermore, the Li disclosure has no reference to the modulation type being applied to the sub-carriers carrying data. It should be apparent that different modulation types can be transmitted using the same power and as such the approach referred to in column 2 would result in pilots being transmitted with the same power for different modulation types, and this would not be a function of the modulation type as required by claim 7.

Claim 10 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Li in view of Baum et al. US 5,867,478. The Examiner concedes that Li does not disclose the claimed pilot pattern is cyclically offset, both in time and frequency direction, for at least one adjacent base station to form re-use patterns. The Examiner then goes on to say that Baum et al. discloses a pilot code scheme with a cellular re-use pattern with three sectors per cell and a base unit located at the center of each cell. This is true, but this is not what is claimed in claim 10. Claim 10 requires that the pattern is offset in time and frequency for an adjacent base station. In Baum et al., there is a re-use scheme for the pilot codes. In particular, orthogonal codes are used to transmit sets of pilot locations. See for example Figure 7 where pilots are inserted for four symbol durations and each base station uses all four of these locations but uses a different orthogonal code. The disclosure the Examiner has referred to relates to the re-use pattern for the code. However, it is readily apparent that there is no offset between the pattern used by adjacent base stations. Rather, the adjacent base station use patterns that are entirely overlapping (i.e. in

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the same locations in the {time, frequency} plane), and use orthogonal codes to separate the pilots transmitted by different transmitters. See for example column 5, lines 15 and 16 where these pilots are referred to as "composite pilot codes".

Claims 11-14, 17, 18 and 29-30 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Li in view of Ariyavisitakul et al. U.S. 6,473,393. The Examiner concedes that Li does not teach the use of multiple transmit antennas. Note that claim 11 as amended also recites specifics of the scattered pattern for the antennas, namely that each scattered patterns is offset with respect to the scattered patterns of each other antenna. The Examiner refers to Ariyavisitakul et al. It is true that this reference teaches multiple transmit antennas. However, they do not use pilot patterns for channel estimation. Rather, the very section identified by the Examiner, namely column 1, lines 61 to 64 refers to the fact that "enhanced performance is obtained by estimating channel parameters during normal operation". Normal operation in the reference is referring to transmission of normal data. Because normal data is being transmitted, and pilots of separate antennas are not transmitted distinctly as claimed in claim 11, rather a complicated mathematics need to be performed in order to separate the signals received from the various antennas.

Thus, combining Li with Ariyavisitakul one does not come up with the claim limitations of claim 11. Specifically, there is no disclosure of multiple antennas being used to transmit scattered patterns as claimed.

There is also no motivation to combine the two references. Li has a first solution for channel estimation, namely the use of a scattered pilot pattern; Ariyavisitakul has a second solution for channel estimation, namely the use of normal data. There is no motivation to combine these to come up with yet another channel estimation scheme.

The limitations of claims 12 through 14 are also not found in the cited references as discussed previously with reference to claims 2, 3 and 4.

The comments presented previously respecting claims 7 and 8 apply to the rejection of claims 17 and 18.

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Allowable Subject Matter

Applicant acknowledges with appreciation the indication that claims 5, 8 to 9, 15 to 16, 19 to 20 and 24 to 26 would be allowable if re-written in independent form. Note that all of these claims depend upon an independent claim that has now been amended. However, these amendments do not make the parent claims any broader, but rather make the parent claims narrower. As such, these claims should still be allowable.

In view of the foregoing, early favorable consideration of this application is earnestly solicited.

Respectfully submitted,

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RAB:rld:kbc